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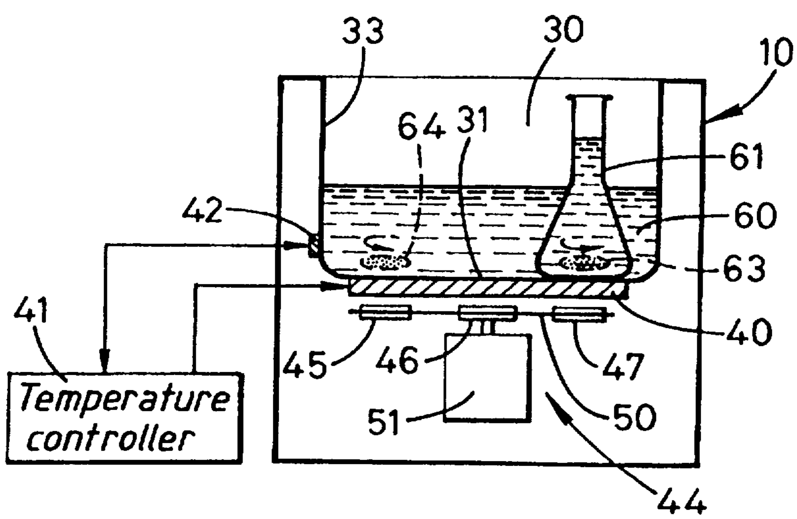

(57) Abstract

This application concerns the field of laboratory apparatus, and in particular relates to apparatus for agitating a laboratory sample, which apparatus comprises magnetic field generation means (45, 46, 47, 51) adapted to generate one or more varying and moving magnetic fields, and sample support means (40) adapted to permit location of said one or more samples adjacent the one or more magnetic fields, one or more magnetically responsive agitation members (63, 64, 73, 114, 223), the arrangement being such that in use movement of agitation members caused by movement of the varying magnetic fields causes agitation of the samples.

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Agitation Apparatus

The present invention concerns the field of laboratory apparatus, and in particular relates to apparatus for agitating laboratory samples.

In recent years the growth of the biochemical industry, and in particular the requirements of genetic engineering, have created a need for the agitation in parallel of many small vessels undergoing similar treatment. This has resulted in the development of shaker systems which are capable of simultaneously agitating many vessels. Typically shakers agitate a carrier rack which holds the vessels (e.g. test tubes) to be agitated. There are a number of problems with this method. The agitation produced is less effective than stirring for thorough mixing of the fluid. Furthermore, in order to prevent spillage, the test tubes may have to be corked, and damage to the fragile test tubes is more likely due to movement of the tubes relative to the shaker rack. Quite apart from these faults the shaker devices are difficult to operate in environments other than at room temperatures.

A There is therefore a requirement for an agitation apparatus which is capable of stirring simultaneously

more than one vessel without the above disadvantages.

In many biological laboratory processes it is necessary to maintain a flow of fluid over an agent. For reliable experimental results and the saving of time, it is necessary to carry out these processes simultaneously upon multiple samples. For example, membrane hybridisation involves maintaining samples at a temperature while passing fluid in the samples continuously over a membrane.

Hence, it is another object of the present invention to provide a method of producing agitation which induces a flow of fluid over a surface and which permits the simultaneous treatment of a large number of specimens conveniently.

In many laboratory processes, particularly in analytical processes and processes involving incubation of cell materials and culture, less violent forms of agitation than stirring is required. In automatic titration, for example, a more gentle rolling of the reaction vessel to produce a "swirl" effect in the contents is desirable, this produces slow steady mixing of the reagents.

In the washing and incubation of microscope slides it is

frequently desirable that the washing/agitation be gentle and violent agitation should be avoided. Hitherto in such cases the alternatives have been to use either a typical stirring device operating at slow speed, or as is the case with incubation systems, the agitation is done by hand.

The disadvantage of manual arrangements are such that they are not entirely reproducible and that furthermore agitation within a controlled environment is not so possible. For example, where an incubation should be carried out at 80° or 90°C then clearly some mechanical agitation is necessary to provide systematic agitation during the incubation period.

Hence it is another object of the present invention to provide means in which a rolling or tilting agitation of a container is provided. In particular this aspect of the invention seeks to provide agitation means capable of producing agitation of a number of different types of apparatus, in particular containers such as flasks, test tubes, beakers, and slide washers and incubation systems.

According to the present invention there is provided laboratory agitation apparatus for agitating one or more samples comprising:-

-magnetic field generation means adapted to generate one or more varying and moving magnetic fields,

-sample support means adapted to permit location of said one or more samples adjacent the one or more magnetic fields,

-one or more magnetically responsive agitation members,

the arrangement being such that in use movement of agitation members caused by movement of the varying magnetic fields causes agitation of the samples.

It will be appreciated that because there is no mechanical connection between the carrier means and the varying magnetic field, the carrier means can be disposed within a container generally permeable to a magnetic field. This allows the agitation to take place in a controlled environment which can be generated within such a container.

According to a first aspect of the present invention there is provided laboratory agitation apparatus for agitating a plurality of laboratory samples, which apparatus comprises magnetic field generation means adapted to generate a plurality of varying and moving magnetic fields, sample support means adapted to permit

location of said samples adjacent said magnetic field generation means, and a plurality of magnetically responsive agitation members each associated with a laboratory sample, wherein outer portions of neighbouring magnetic fields overlap, the arrangement being such that an agitation member disposed in an overlapping portion responds thereto to effect agitation of its sample whereby more agitation members than there are varying magnetic fields may be employed to effect agitation.

The plurality of varying magnetic fields may counter-rotate one with respect to another, thereby to enhance the magnetically influenced motion of an agitation member located in an overlapping portion.

One or more of the agitation members may be configured as a tetrahedral pyramid. Two or more points of the pyramid may have polarized.

In a second aspect of the present invention there is provided guide means for an agitation member for use with laboratory apparatus as herein described, which agitation member is configured as a stir bar adapted to agitate by movement relative to a fluid in which the stir bar is immersed, which guide means comprises an insert for use with a sample vessel for containing a fluid sample, which

insert, on insertion into said vessel, provides a chamber for accommodating the stir bar and wherein rotation of the stir bar displaces fluid thereby to cause movement of fluid over a surface portion of said insert.

The agitation member may be configured as a water screw or paddle thereby to promote fluid displacement during agitation.

The insert may comprise an elongate member such as a cylinder and said surface portion may be located on an outside surface of said elongate member. A passage may extend longitudinally through the elongate member to permit recirculation of fluid between said chamber and said surface portion or vice versa.

The chamber may comprise a recess formed at one end of said insert. The recess may be defined by an annular collar portion at one end of said insert. The collar may be provided with one or more orifices which permit radial displacement of water moved by an agitation member accommodated in the chamber.

The surface portion of the insert is preferably adapted to carry an agent to be treated in the moving fluid, for example by the provision of a mesh which may be

impregnated with the agent.

The chamber may comprise a recess formed at one end of said elongate member. A bottom wall of the chamber may comprise a portion of the vessel wall. The recess may be defined by a collar at one end of the elongate member. In this way the stir bar is constrained for rotation about a longitudinal axis of the insert (or an axis parallel thereto). The collar may be provided with one or more orifices which permit radial displacement of water moved by a stir bar in the chamber. In such a configuration water is displaced out of the chamber in a radial direction whatever the direction of stir bar rotation.

The surface portion of the insert may be adapted to carry an agent to be treated in the moving fluid. For example the surface portion may carry a mesh impregnated with the agent. In a preferred embodiment the mesh is wrapped around the outside surface of the insert.

The insert is preferably configured and sized such that the fluid flow path over said surface portion is formed in a gap between the insert and a wall portion of the vessel. In the case of a test tube therefore, an annular cavity may be defined between the surface portion of the

insert and the inner wall of the tube. In this way the fluid flow path may be formed simply by entering the insert into the fluid vessel.

The above disclosed apparatus for the treatment of an agent in a stream of fluid is particularly useful for the treatment of biological samples. In one application of this aspect of the invention the apparatus is used for the membrane hybridisation of a biological sample.

In a third aspect of the present invention there is provided laboratory agitation apparatus for agitating one or more samples comprising magnetic field generation means adapted to generate one or more varying and moving magnetic fields, sample support means adapted to permit location of said one or more samples adjacent the one or more magnetic fields, one or more magnetically responsive agitation members, and further comprising a sample rolling/tilting assembly comprising sample vessel carrier means for supporting and locating one or more sample vessels, flexible suspension means for supporting said vessel carrier means relative to a fixed point whereby the carrier means is capable of movement in a manner permitted by the suspension means, wherein the agitation member is disposed for movement with said carrier means and has a magnetic pole, the arrangement being such that,

in use, attraction of said agitation member towards an opposite polarity portion of the varying magnetic field causes said vessel carrier means to adopt a tilted orientation by flexing of said suspension means and movement of said agitation member with said varying magnetic field causes said vessel carrier means to follow movements in said portion of the magnetic field thereby imparting to the carrier means a rolling motion due to the constraint applied by the flexible suspension means.

The flexible suspension means may comprise a resilient flexible suspension member adapted to engage with an end portion of said carrier means and wherein a portion of said carrier means remote from said end portion is provided with the agitation member.

The suspension means and the agitation member may be disposed coaxial with, or substantially coaxial with, an axis of rotation of a varying rotating magnetic field generated by said magnetic field generation means, the arrangement being such that, in use, the remote portion of the carrier means follows a circular path around said axis of rotation.

The effect of the dynamic field is, therefore, to provide a continuing tilting motion to the carrier means as the

magnetic means carried thereby seeks to follow the movement in the varying field. In one embodiment of this aspect of the invention the varying field is simply rotational, which means that the fixed magnet associated with the carrier means simply attempts to follow the rotation of the opposite pole of the varying field. In a particular embodiment of this aspect of the invention the axis of the carrier means may be substantially coaxial with the axis of rotation of the rotating magnetic field. In these circumstances, the effect of the permanent magnet associated with the magnetic means will be to induce a permanent "tilt" to the carrier means and as the field rotates the angle of tilt changes so that the base of the carrier means describes a circular motion while the flexible means serves to restrain the upper end into a relatively fixed location.

In another aspect of the invention, the carrier itself may be a container and in a typical embodiment of the invention the carrier may be configured in the form of the container having means for supporting additional sample vessels therein. In another aspect of the invention the apparatus may be employed for washing and/or incubation of microscope slides. The carrier may be in the form of a container having means for introducing water or a controlled atmosphere into the

container and may be configured to accommodate slides by providing a series of groves to receive them. The slides may be supported in a back to back relationship with two slides per groove.

In another aspect of the invention an enlarged static container may be provided with a magnetic field generated underneath. An insert may be located in the container having a number of flexible suspension means therein. Each flexible suspension means may comprise a rubber grommet or bung located in a hole in the support, said grommet or bung having a central hole adapted to engage with a spigot on the carrier means. In the stationary mode, therefore, the carrier means is suspended from the grommet by means of the inter-engagement between the spigot and the grommet. In a preferred embodiment of the present invention the spigot is provided with an enlargement towards and end thereof which is forced through a smaller hole in the grommet or bung so that the enlarged portion projects on the upper side of the grommet remote from the body of the carrier. In this way the weight of the carrier means is carried by the flexible suspension means which serves to locate the upper end of the grommet but allows a free swinging motion of the carrier means relative to the flexible suspension means.

A permanent magnet, typically a ferrite magnet, may be disposed at or towards the lower extremity of the carrier means and the varying magnetic field may then be applied. This will cause the seeking pole of the ferrite magnet to swing in a rotary swinging motion about the rubber bung. The precise nature of the motion will depend upon the nature of the movement of the magnetic field and the relative position of the fixed magnet means applied to the carrier means. While having the permanent magnet affixed generally axially of the carrier means will provide a symmetrical movement of the carrier means in the varying field, the setting of the magnet "off axis" will have the effect of producing a different type of motion to the carrier.

It will be appreciated by the man skilled in the art that many variations of this arrangement are possible.

According to further aspects of the present invention there is provided apparatus as hereinbefore described and provided with one or more of the following features taken alone or in combination:

(a) The magnetic field generation means provides one or more rotating magnetic fields.

(b) The one or more agitation members comprises a stir bar, each stir bar containing one or more magnetically responsive cores.

(c) The stir bar may be rod-shaped, triangular, pyramidal or of any suitable shape or configuration which causes a mechanical moment to act on the stir bar under the influence of a magnetic field.

(d) The stir bar may be provided with a coating of plastics material, preferably rubberised to lessen the chance of damage to the vessel being stirred.

(e) The stir bar may be in the configuration of an elongate bar with a pole at each end.

(f) The stir bar may be configured as a propeller or a paddle with a magnetic pole in an arm of two or more blades.

(g) Guide means may be provided for each stir bar to prevent unwanted lateral motion of the stir bar which may occur when the stirring means is not exactly aligned with a corresponding field generation means.

(e) The guide means may comprise a spigot which engages

with the stirring means to provide an axle.

(f) The guide means may comprise the walls of a sample vessel in which each stir bar may be placed. The vessel walls will prevent unwanted lateral motion while allowing rotation or wobbling which aids mixing.

(g) In arrangements where the stir bar and magnetic field are offset each stir bar is preferably pyramidal or configured as a tetrahedron. These latter shapes provide adequate stirring performance, but because they have a small moment of inertia, they are also able to spin under the influence of non-uniform, weak or asymmetric magnetic fields.

(h) The dynamic magnetic field generating means may be mechanical or electrical.

(i) Typical mechanical means may include the mechanical rotation of one or more a permanent magnet.

(j) In the case of electrical means, the rotation may be produced by relative phase displacement of an alternating current present in two or more electric coils. Suitable electric means include, for example, two or more phase-displaced coils disposed around a nominal axis of stir

bar rotation.

(k) In a preferred arrangement the field generation means comprises five rotating magnetic field generation devices. These may be configured such that one central generation device is adapted to produce a field which rotates in a first direction, and four more disposed around said central means are adapted to produce a field which counter-rotates with respect to the central device.

(l) The agitation apparatus may be incorporated in a device which provides for heating of the fluid to be agitated as well as agitation. The method of heating may be direct i.e. conduction, or indirect i.e. induction though he fluid vessel. The heating means may be operated independently of the agitation means, or linked to operate in synchronisation therewith. The agitation apparatus of the invention may also be used in ovens, pressure vessels and the like, thus providing means for agitation of a plurality of specimens under identical conditions.

(m) Sample vessels suitable for use with the present invention may be any magnetically permeable vessel. Suitable vessels include, for example baths, flasks, beakers and test tubes. Suitable vessel materials are

glasses, ceramics or plastics materials.

(n) On or more racks may be provided to maintain the vessels in an upright position. In one particular embodiment a rack is provided to support an array of test tubes, and each test tube is provided with stirring means. In this way a plurality of test tubes may be stirred by a single, or few, magnetic drives.

(o) The vessel contents may comprise a liquid, a culture, a sample and may be accommodated on a plate or viewing slide.

(p) The carrier means may be adapted to carry one or more containers such, for example, as test tubes so that as the carrier rotates each of the containers effects a rotating swinging motion corresponding to that of the carrier. The intensity of the agitation is, therefore, dependent on the extent of the movement, the area over which the movement of the varying magnetic field takes place, and the frequency of the moving cycle of the magnetic field.

(q) The sample support means may comprise a magnetically transparent or substantially transparent plate beneath which is located the magnetic field generation means. The

support means may further comprise container for a fluid bath, along with optional heating elements.

Following is a description by way of example only and with reference to the drawings of methods of carrying out various aspects of the present invention.

In the drawings:-

Figure 1 is a perspective view of a magnetic stirrer according to one aspect of the present invention.

Figure 2 is a perspective view, partially cut-away, of a stir bar for use with a stirrer according to the present invention.

Figure 3 is a cross-sectional view from one side of a schematic representation of a stirrer according to the present invention.

Figure 4 is a cross-sectional view from on side of a test tube rack and pyramidal stir bars suitable for use with a magnetic stirrer according to the present invention.

Figure 5a is a cross sectional view through a single test

tube which contains an insert according to one aspect of the present invention.

Figure 5b is an enlarged view, in prospective, of a lower end of the insert of Figure 5a.

Figure 5c is a stirring bar, to be constrained by the insert of Figure 5a and 5b.

Figure 6 is a schematic view of an insert in use.

Figure 7 is a perspective view of a support with flexible mounting and carrier assembly for disposing test tubes in a water bath.

Figure 8 is a detail of Figure 7.

Figure 9 is a detail of figure 8 showing the effect of the magnetic field.

Figure 10 is a diagram of a microscope slide washer in accordance with the invention.

Figure 11 is a detail of Figure 10.

Figure 12 illustrates the rolling agitation principal.

Figure 13 illustrates the slide mount for use in the container of Figure 10.

Figure 14 shows the method of mounting two slides per mount location of Figure 13.

Figure 15 is a support assembly for use in conjunction with a water bath and multiple rotating magnet assembly.

First Embodiment

Magnetic stirring apparatus according to the present invention is generally shown in figure 1. The apparatus comprises a stainless steel rectilinear housing (10). The housing has two upstanding sidewalls (11) and (13). The sidewalls are closed at one end by an upstanding back wall (14) and at the other end by an upstanding front wall (12). The front wall (12) is stepped to form a lip (20). Lip (20) defines a surface for the mounting of a control panel (21). The control panel is provided with an on/off switch (22), a temperature dial (23) and a stirring speed control (24).

The upper extremities of the sidewalls and front and back walls together define a rectangular opening (15). The opening forms the open top of a fluid tank (30) formed

in the housing. The fluid tank (30) has a bottom wall (31) and two upstanding interior sidewalls (32) and (33) and interior front (34) and rear walls (35).

In figure 2 a stir bar (37) comprises an iron rod (38) encased in a sheath (39) of rubberised plastics material. The sheath has an elongate form, which barrels in the centre. The centre thereby provides a contact point when the bar is placed on a surface, and this point provides a pivot for rotation.

In figure 3 a schematic view of the interior of the housing shows the internal workings of the stirrer. The bottom (31) of fluid tank (30) is provided with a heater plate (40) which is linked to a temperature controller (41). The temperature controller receives temperature feed back from a temperature sensor (42) placed against sidewall (33).

Under the heater plate (40) the magnetic drive (44) is mounted inside the housing. The magnetic drive comprises five magnetic discs (45, 46, 47, 48) and (49) (48 and 49 are not visible in figure 3). The discs are rotatable mounted parallel to the bottom (31) of the fluid tank, directly under and spaced apart from the heater plate (40), and in the arrangement shown in figure 1. The discs

are each supplied with gear teeth adapted to be engaged with a toothed belt (50). The toothed belt is arranged so that the central disc (46) will rotate in use in the opposite direction to the surrounding discs (45,47,48 and 49). Disc (46) is mounted on the drive shaft of a motor (51) which sits beneath disc (46) in the housing. Disc (46) and the other discs (45, 47, 48 and 49) are thereby drivably connected to the stepper motor. The stepper motor includes a speed controller which is operable from the control panel (20).

In use the tank (30) is filled with fluid, such as water to form a fluid bath (60) into which may be placed the reaction vessels. The fluid bath is shown in figure 3 to contain a conical flask (61). The flask contains a reaction fluid which is to be stirred. Inside the flask a stir bar (63) is disposed. Another stir bar (64) is disposed on the bottom of the tank.

The heater plate heats the bottom (31) of the tank by conduction. When the stepper motor (51) is activated the discs are driven, thereby creating a rotating magnetic field which acts in the region of the bottom of the tank. The stir bars are placed so that each one is aligned with the magnetic field of a disc. Rotation of the magnetic field causes the stir bars to rotate, thereby agitating

the fluid around each stir bar. The reaction vessel is thus stirred, while uniform temperature is maintained in the water bath by the action of stir bar (64) which ensures that water continually passes over the heated bottom of the tank.

Figure 4 demonstrates another aspect of the present invention. A test tube rack (70) is of suitable dimensions to be placed inside the tank of the magnetic stirrer (10). The rack is made of a wire mesh (not shown) of stainless steel and is adapted to mount vertically, and spaced apart, up to 144 test tubes in an array of 12 x 12 (four test tubes 75,76,77 and 78 are shown in figure 4). The rack is equipped with two lips (71, 72) which are adapted to support the rack on two opposite edges of the magnetic stirrer housing opening. Each test tube to be stirred is provided with a triangular (i.e. four faced) pyramidal stir bar (73). The stir bar has an iron core and a rubberised plastics coating.

In use, the rack is placed in the water bath, which may contain fluid or be empty as required. The rack positions the lower end of each test tube just above the bottom (31) of the tank. The test tubes will typically have been filled with reagents or the like, and may then be each provided with a stir bar. Upon activation of the stirring

mechanism, the rotating magnetic field, and interactions between neighbouring magnetic fields cause all of the stir bars to be agitated and/or rotated to effect stirring. By this method, a number of vessels can be stirred by a limited number of magnetic drive means. In the above example 144 stirrers are driven by only 5 drive means.

Second Embodiment

A test tube is shown as (100) in Figure 5. An insert (110) is an upstanding elongate cylindrical member entered into a test tube (109). A lower end (111) of the insert abuts the bottom wall (108) of the test tube. The said lower end of the insert is configured with a depending annular collar portion (112) which defines a cylindrical recess in the lower end. Inside the recess is disposed an egg-shaped magnetic stirring bar (114), which comprises a bar magnet inside the egg shaped PTFE moulding. A longitudinal passage (115) extends axially of the insert from the recess upwards in the insert to a top end (116) thereof.

An annular chamber (107) is defined between an external cylindrical surface (120) of the insert and the upstanding wall (106) of the test tube. The surface of

the insert is provided with a nylon mesh sleeve (121), in the present embodiment monopil swiss 53 micron mesh.

In Figure 5b the configuration of the lower end (111) of the insert is shown enlarged. The collar portion (112) is provided with the four axially spaced semi circular cut outs (125) which each define a radial exit direction for water displaced by the stir bar when rotating.

In Figure 6 a schematic representation of the test tube (100) in Figure 5 is shown in use. A fluid (130) is shown in the test tube (109) and the test tube itself is in a heated water bath (131) and held over a magnetic rotating drive head (132) and supported by a base plate (133). In use the rotation of the stir bar causes radial displacement of fluid out of the recesses (125) at the lower end (111) of the insert. The fluid then rises in the annular gap (107) between the upstanding walls of the test tube and the cylindrical surface of the insert (flow directions indicated by the arrows in Figure 6). At the top of the test tube the water recirculates towards the recess by descending through the passage (115). In this way a constant flow of fluid is maintained over the mesh (not shown in Figure 6) which itself contains or carries a biological sample to be treated. This apparatus and method is particularly suited to carrying out membrane

hybridisation of biological samples under controlled heating.

Third embodiment

Turning now to the device in Figure 7, a support plate (210) is arranged to be mounted substantially horizontally in a water bath and is supported on the base of the water bath (not shown) by a plurality of legs (211). Each of the legs are mounted substantially inwardly of the exterior periphery (212) of plate (210) and substantially mid-way along each side. Towards the "corner" portions (213) of plate (210) there is provided a circular hole (214) adapted to accommodate a recessed grommet (215) made of rubber. Each grommet has a central hole (216) adapted to accommodate the spigot (217) of a carrier member (220). The spigot (217) extends downwardly towards the base (25) of the water bath or container and terminates in an enlarged portion (221) which accommodates a permanent magnet (222). Towards the junction of the spigot (17) and the enlarged portion (221) there is provided a generally circular plate (223) having a plurality of holes (224) each of which is adapted to accommodate a test tube (225). The plate has a plurality of depending legs (226) so that the carrier (220) is capable of free standing on a surface when not

installed in the machine. The spigot (217) is provided towards its upper end with a wasted portion (218) terminating in a part-spherical end portion (219) The arrangement being such that the hole (216) and the grommet (215) is a tight fit on the wasted portion (218) of spigot (217) and that in order to insert the carrier into the grommet the part-spherical portion (219) is forced through the hole (216) so that at rest carrier (220) is dependant from and supported by said grommet.

Beneath the base (205) of the water bath there is provided a rotating magnet arrangement (230) in the manner described hereinbefore. On rotating the magnet the north pole of the magnet (221) will be attracted towards the south pole of the rotating magnet (230) with the result that the carrier (220) will "tilt" under the influence of the magnetic field and the restraint of the grommet (215). Rotation of the magnet (230) will result in permanent magnet (221) following the south pole of the rotating magnet (230), with a result that the carrier will execute a circular motion at its base while relatively fixed at the upper end of the spigot (217) (see Figure 9).

This device provides a gentle and systematic agitation to samples contained in the test tubes or indeed in any

other containers carried by the carrier. The containers can be located in the water bath as shown or in any other container to provide an environment in which the agitation takes place. Apparatus in accordance with the present invention is, therefore, ideally suited to incubation systems, washing systems and the like.

Fourth embodiment

Turning now to Figure 10, in this embodiment there is provided a container suitable for use for the washing/incubation of microscope slides. The device comprises a container (240) of generally cylindrical construction having a screw closure (241). The closure (241) is provided with an upstanding spigot (242) having a hose barb (243) towards the upper end thereof. The closure (241) also includes a port (244) which is suitable for the introduction of material or for venting the interior of the closure as the case may be. In an alternative embodiment the body of container (240) may be generally frusto-conical which tapers towards its base (246). A false bottom (247) is adapted to accommodate a ferrite magnet (248) and the bottom (247) is welded at (249) to the external surface of body (240).

In use the barb (243) is entered through hole (216) in

grommet (218), as previously described, until the underside of the barb (243) is juxtapose the upper surface of the grommet. The container (240) is then suspended by means of grommet (218) from support (210). The support (210) may have the general configuration shown in Figure 15, which may in itself be adapted to co-operate with a stirring device as hereinbefore described.

The internal surface of body (240) may be provided with a plurality of slide guides (250) as shown in Figure 13. Each guide may be adapted to accommodate a pair of microscope slides which are mounted back to back, as shown in Figure 14. Pairs of slides are adapted to be entered into each of slots (240, 250) so that, as shown in Figure 13, ten slides may be accommodated within the five slots. Where only one sample is to be incubated then the slide is presented back to back with a blank slide.

In operation the effect is as described with respect to Figures 7 and 8.

In the multiple construction illustrated in Figure 15 this allows up to fifty slides to be agitated and incubated using the rotating drive heads which "couple" with the ferrite magnet (248) in the false bottom of each

container. This effects a rotating swinging of the base of the container and causes agitation of the fluid within the container. The whole unit with the containers shown in Figure 15 may be suspended in a tank which is temperature controlled, typically a water bath, in order to effect satisfactory incubation of slide samples.

CLAIMS

1. Laboratory agitation apparatus for agitating one or more samples comprising:-
-magnetic field generation means (45, 46, 47, 51) adapted to generate one or more varying and moving magnetic fields,
-sample support means (40) adapted to permit location of said one or more samples adjacent the one or more magnetic fields,
-one or more magnetically responsive agitation members (63, 64, 73, 114, 223), the arrangement being such that in use movement of agitation members caused by movement of the varying magnetic fields causes agitation of the samples.

2. Apparatus as claimed in claim 1 wherein the magnetic field generation means produces a plurality of varying magnetic fields, outer portions of which fields overlap whereby an agitation member disposed in an overlapping portion responds thereto to effect agitation, the arrangement being such that more agitation members (73) than varying magnetic fields may be employed to effect agitation of a plurality of samples.

3. Apparatus as claimed in claim 2 wherein the plurality of varying magnetic fields counter-rotate one with respect to another, thereby to enhance the magnetically influenced motion of an agitation member located in an overlapping portion.

4. Apparatus as claimed in any one of the preceding claims wherein one or more of the agitation members (73) is configured as a tetrahedral pyramid.

5. Apparatus as claimed in any preceding claim and further comprising at least one guide means for one or more agitation members, which guide means comprises an insert (120) for use with a sample vessel (109) for containing a fluid sample, which insert, on insertion into said vessel, provides a chamber in which may be accommodated an agitation member (114) and wherein agitation of an accommodated agitation member causes movement of fluid over a surface portion of said insert.

5. Apparatus as claimed in claim 4 wherein the or each agitation member is configured as a water screw or paddle thereby to promote fluid

displacement.

6. Apparatus as claimed in claim 4 or claim 5 wherein the insert comprises an elongate member such as a cylinder and said surface portion is located on an outside surface of said elongate member.

7. Apparatus as claimed in any of claims 4 to 6 wherein a passage (115) extends longitudinally through the elongate member to permit recirculation of fluid between said chamber and said surface portion or vice versa.

8. Apparatus as claimed in any of claims 4 to 7 wherein the chamber comprises a recess formed at one end of said insert.

9. Apparatus as claimed in claim 8 wherein the recess is defined by an annular collar portion (112) at one end of said insert.

10. Apparatus as claimed in claim 9 wherein the collar is provided with one or more orifices (125) which permit radial displacement of water moved by an agitation member accommodated in the chamber.

11. Apparatus as claimed in any of claims 4 to 10 wherein the surface portion of the insert is adapted to carry an agent to be treated in the moving fluid, for example by the provision of a mesh which may be impregnated with the agent.

12. Apparatus as claimed claim 1 and provided with sample rolling/tilting apparatus (210) comprising sample vessel carrier means (223) for supporting and locating one or more sample vessels, flexible suspension (215) means for supporting said vessel carrier means relative to a fixed point whereby the carrier means is capable of movement in a manner permitted by the suspension means, at least one agitation member (228) disposed for movement with said carrier means and having polarity, the arrangement being such that, in use, attraction of a portion of said agitation member towards an opposite polarity portion of the varying magnetic field causes said vessel carrier means to adopt a tilted orientation by flexing of said suspension means and movement of said agitation member with said varying magnetic field causes said vessel carrier means to follow movements in said portion of the magnetic field thereby imparting to the carrier means a rolling motion due to the

constraint applied by the flexible suspension means.

13. Apparatus as claimed in claim 12 wherein the flexible suspension means comprises a resilient flexible suspension member (215) adapted to engage with an end portion (218) of said carrier means and wherein a portion (221) of said carrier means remote from said end portion is provided with the agitation member (222).

14. Apparatus as claimed in claim 13 wherein said suspension means and said agitation member are located coaxial with, or substantially coaxial with, an axis of rotation of a varying rotating magnetic field generated by said magnetic field generation means, the arrangement being such that, in use, the remote portion of the carrier means follows a circular path around said axis of rotation.

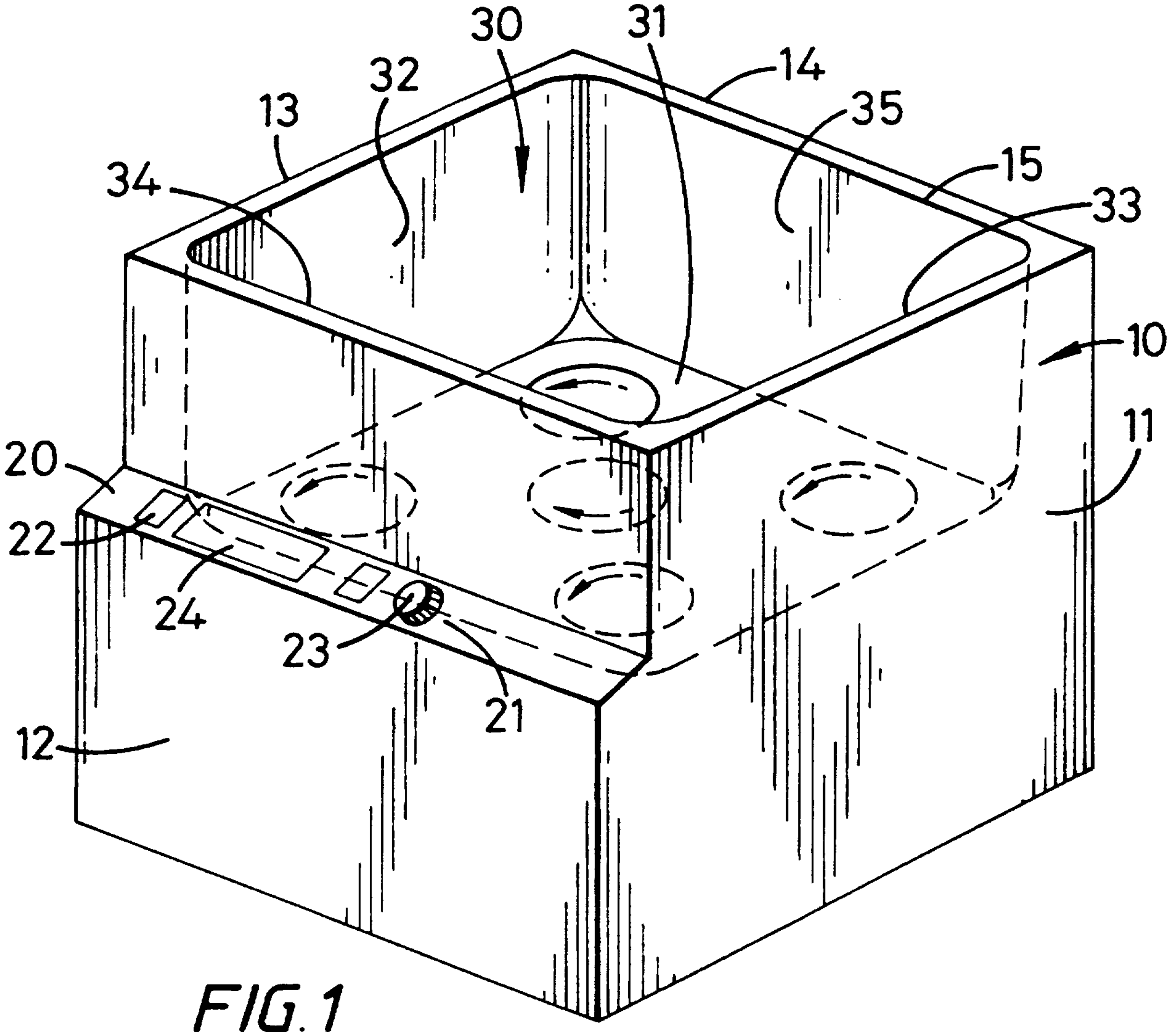


FIG.1

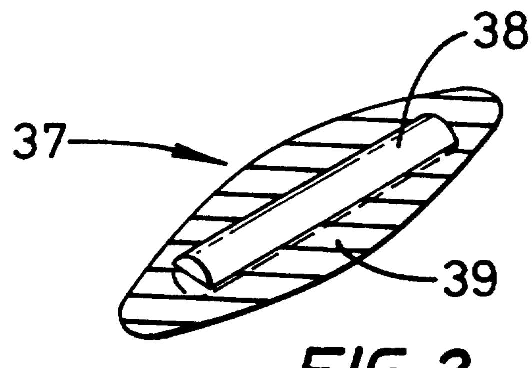
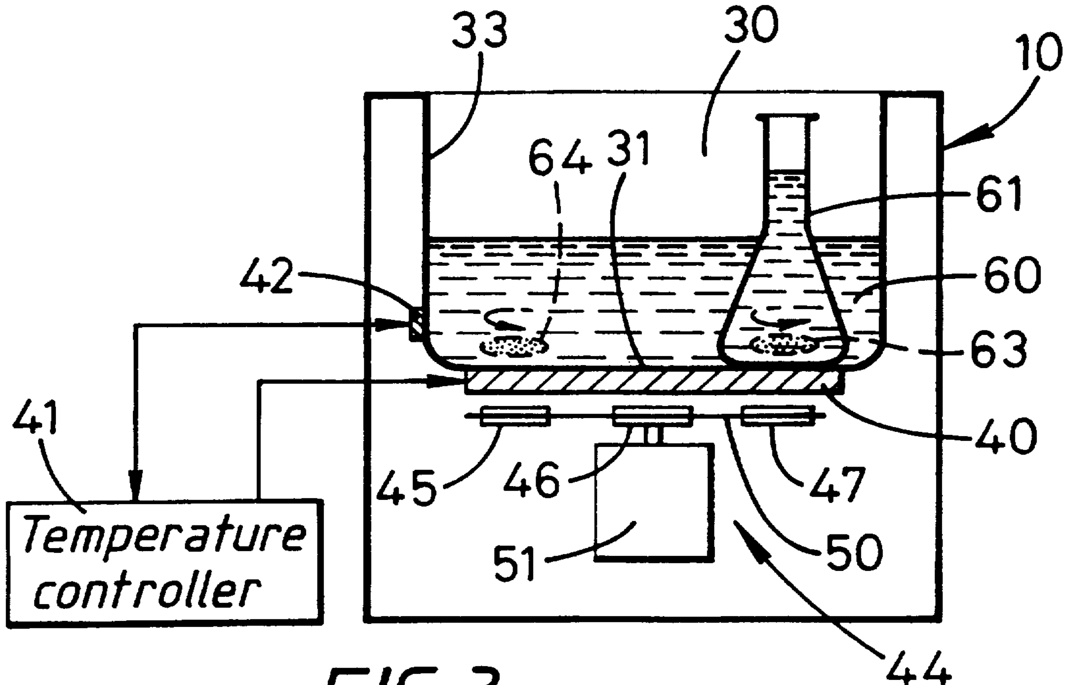


FIG. 2


33
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Temperature controller
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FIG. 3

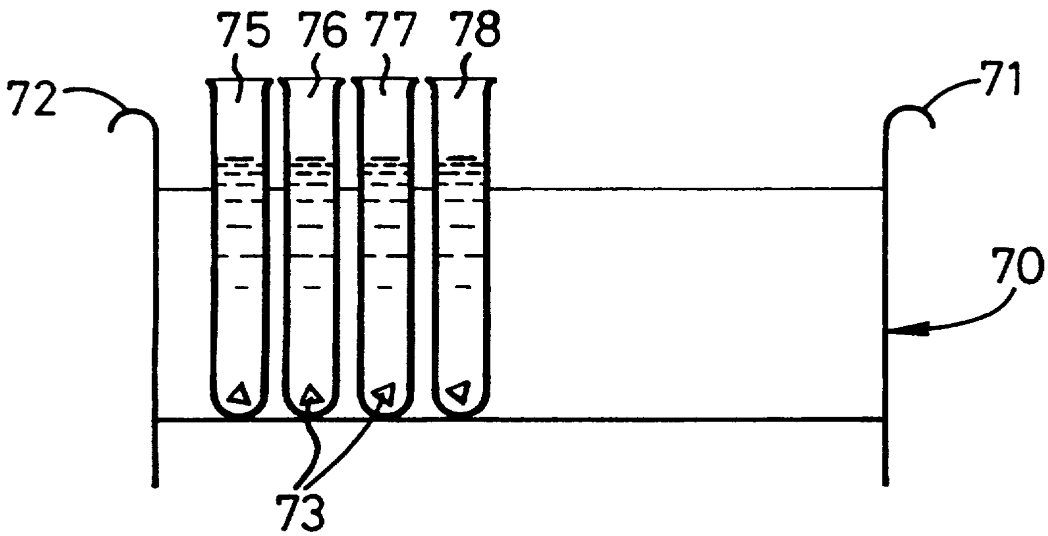
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FIG. 4

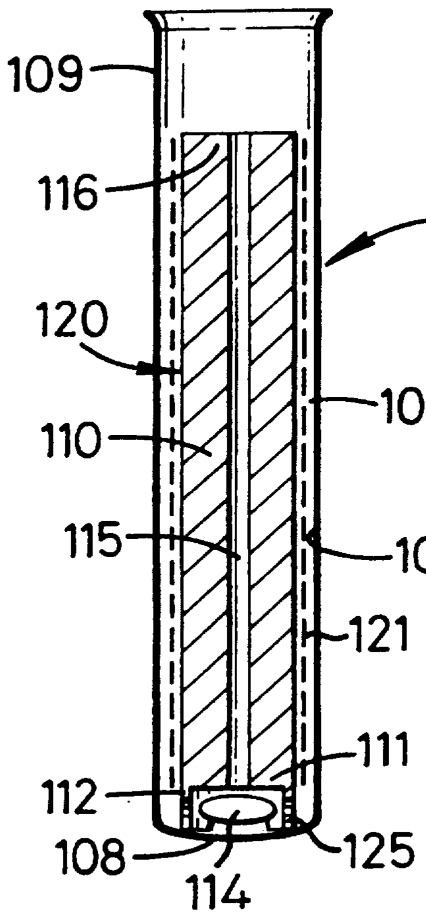

FIG.5a

FIG.5c

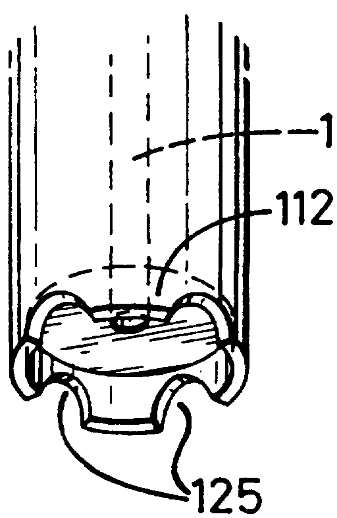

FIG.5b

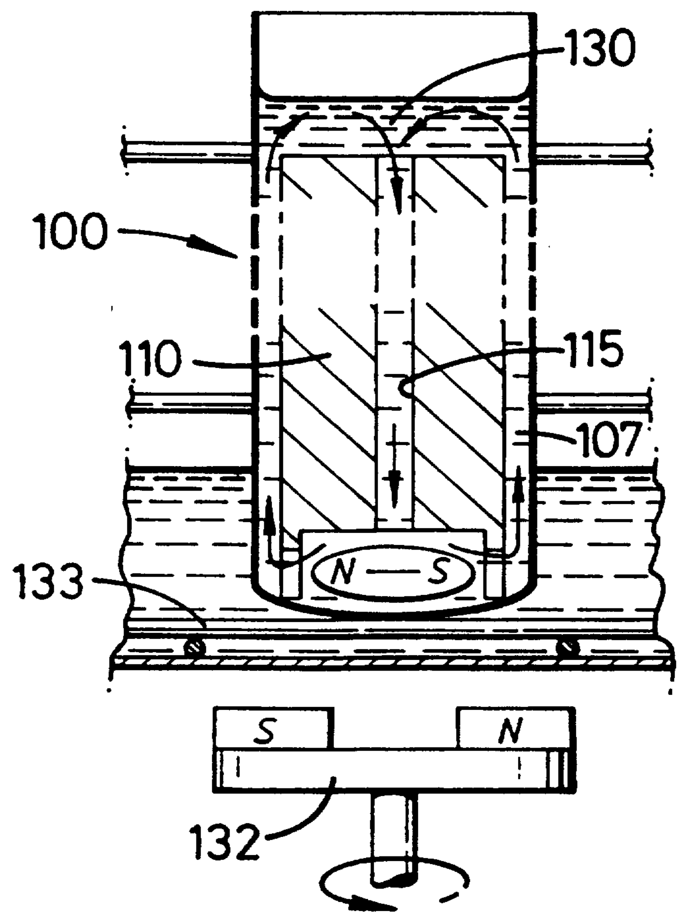

FIG.6

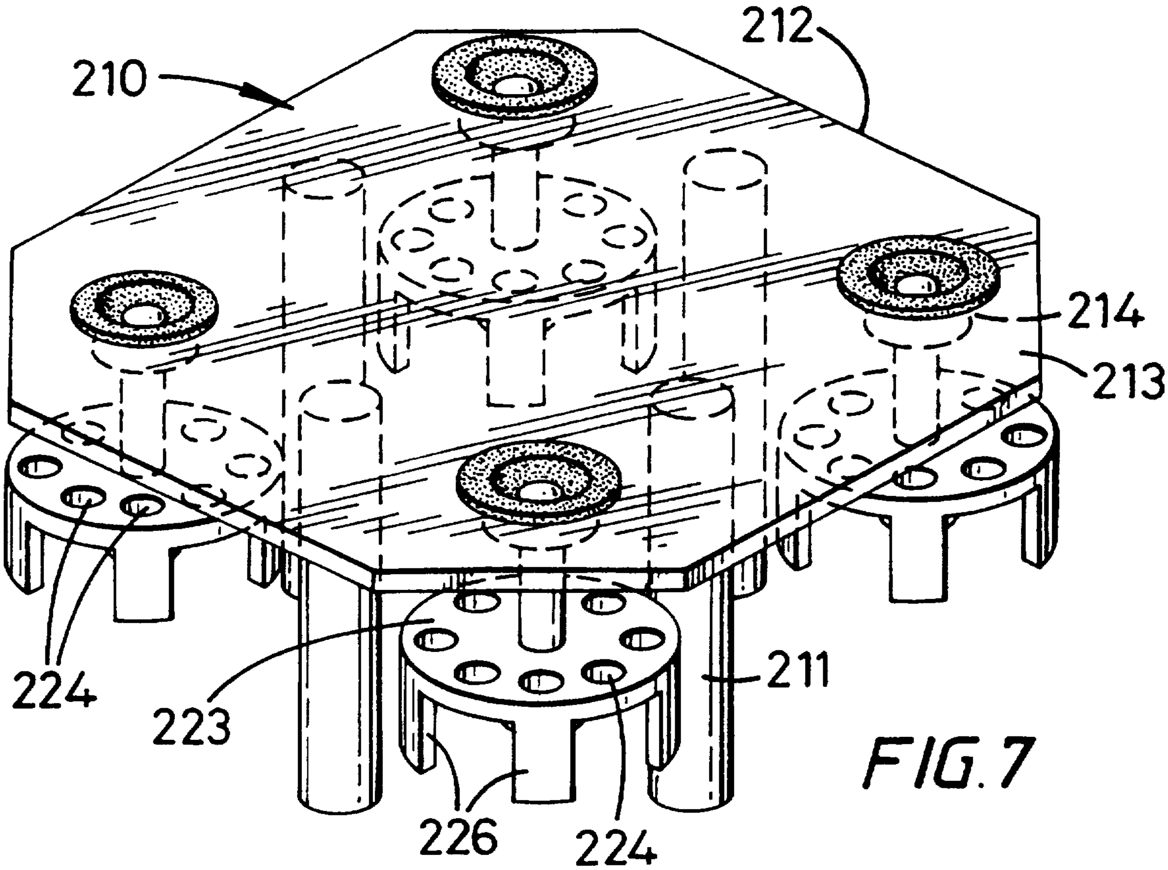

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FIG.7

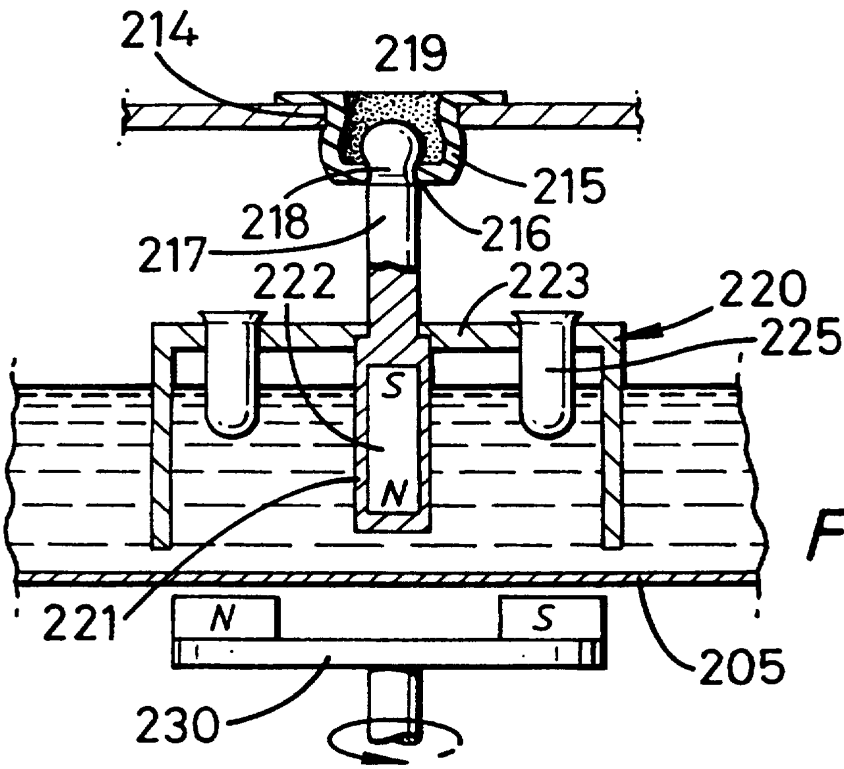

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FIG.8

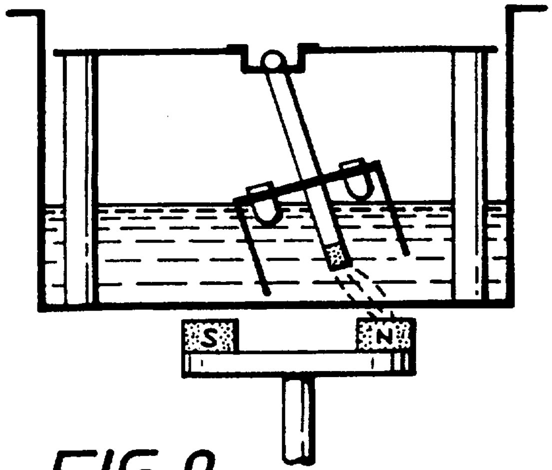

FIG. 9

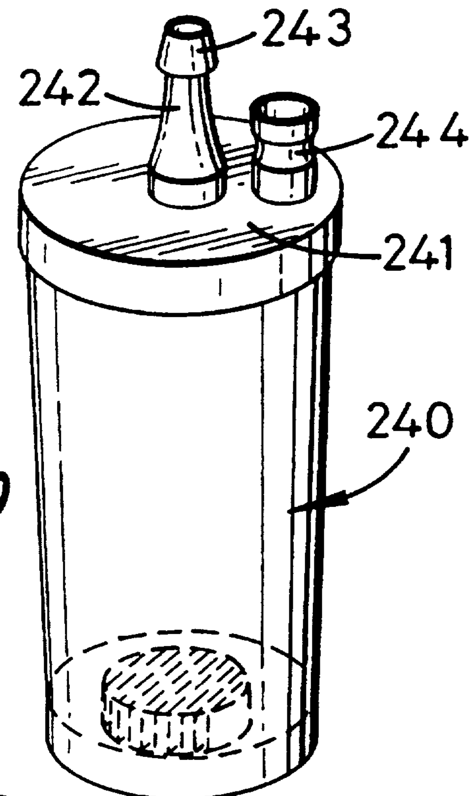

FIG. 10

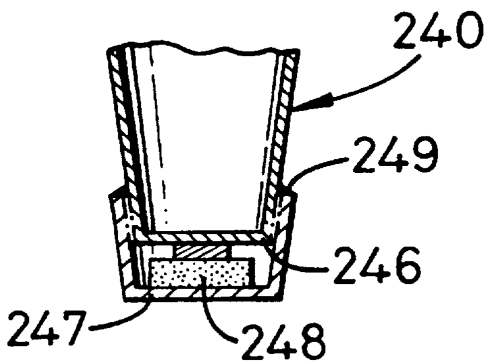

FIG. 11

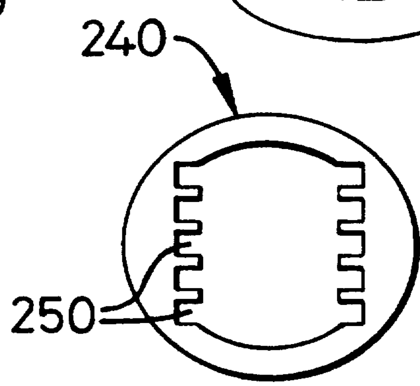

FIG. 13

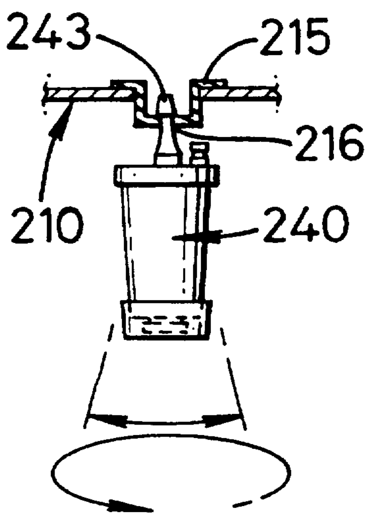

FIG. 12

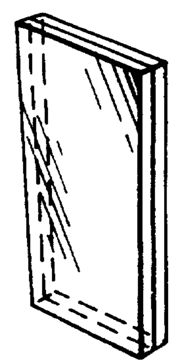

FIG. 14

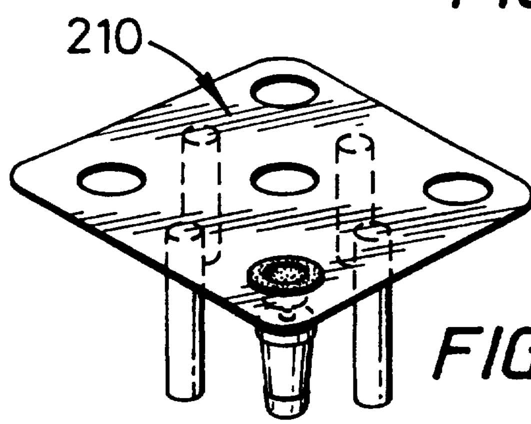

FIG. 15

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 97/02146

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B01F13/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 154 112 A (HERZ HELMUT ;KAUFMANN KLAUS (DE)) 11 September 1985 see the whole document ---	1-3
X	US 3 784 170 A (PETERSEN A ET AL) 8 January 1974 see abstract; figures 3-5 ---	1
X	US 4 477 192 A (BONNEY WARREN J) 16 October 1984 see column 2, line 36 - column 4, line 39; figures 3,4 ---	1
X	DE 33 44 754 A (REDEKER JOERG) 20 June 1985 see the whole document --- -/--	1

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

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"&" document member of the same patent family

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Date of the actual completion of the international search	Date of mailing of the international search report
20 November 1997	- 3. 12. 97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Hoffmann, A

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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